Observations and Comparisons of California Seamount Communities

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Introduction

Seamounts provide hard substratum, complex habitat, and other conditions which favor faunal assemblages that differ from those found on flat, sediment-covered benthos more typical of the deep-sea (Gage and Tyler 1991). Due to these physical characteristics, seamount organisms may be very diverse, abundant, and highly endemic (Richer de Forges 2000). Seamounts are home to unique corals, sponges, and other sessile invertebrates. Enhanced productivity in the water column surrounding some seamounts may be due to either the formation of Taylor columns and/or entrapment of migrating zooplankters (Rogers 1991).

Davidson, Guide, Pioneer, and Rodriguez Seamounts have similar intraplate volcanic origins and each is located atop older oceanic crust which formed 19-20 million years before present (MYBP). These four seamounts have a similar northeast-to-southwest orientation, indicating that they may have formed astride an abandoned mid-ocean ridge system (Davis *et al.* in press). Though formed under similar conditions, the topography, size, and depth of the seamounts examined here vary (Fig. 1, Table 1). Rodriguez Seamount is unique among this group in that it was subaerially exposed approximately 10 MYBP and is flat-topped (Guyot) with rugged flanks and extensive flat regions encrusted with pavements and a thin sediment veneer.

Seamount communities in many regions of the world have suffered at the expense of deep-water fisheries such as those found near Tasmania, where trawling for orange roughy has decimated fragile seamount communities (Koslow, et al. 2001). In this investigation we used video recordings from remotely operated vehicle (ROV) dives to look for patterns of diversity. These ROV dives were conducted for geological studies, yet they provide valuable information about the biological composition of these deep-sea habitats.

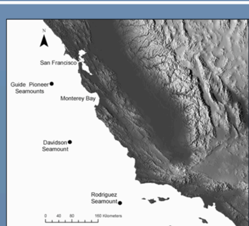


Figure 1. Location of Guide, Pioneer, Davidson, and Rodriguez Seamounts

Seamount	Distance from shore (km)	Depth at Foot (m)	Depth at Summit (m)
Davidson	150	3,656	1256
Rodriguez	150	2,325	650
Pioneer	120	2,750	820
Guide	120	3,122	1682

Table 1. Physical characteristics of each seamount

Methods

Geological features and biological communities were observed using the Monterey Bay Aquarium Research Institute's (MBARI) ROV *Tiburon*. Twelve dives (120 hours of video) on Davidson, Guide, Pioneer, and Rodriguez seamounts off the coast of California, USA (Fig. 1), were annotated using MBARI's Video Annotation and Reference System (VARS, Fig. 2) to determine seamount community composition. VARS facilitates the creation, storage, and retrieval of video annotations based on ROV dive tapes. The VARS components reference a knowledge database of over 3,000 biological, geological, and technical terms. This hierarchical information allows for consistent and rapid classification, description, and complex querying of objects observed on video.

We identified benthic and demersal megafauna to the lowest possible taxon. Some species were collected and identified by taxonomists. Each video observation was merged with ancillary data (geographic position, CTD, and camera information) within VARS. Video observations were imported into ArcGIS® 9.1 and mapped along with high-resolution bathymetric data. Thirty-meter bathymetric grids were analyzed using ArcGIS's Spatial Analyst Extension to calculate Aspect and NOAA's ArcGIS Extension, the Benthic Terrain Modeler (BTM), to calculate Bathymetric Position Index (BPI) for each observation. We conducted Chi-square tests to compare the distribution of observed organisms with the expected distribution (our tracklines). Due their close proximity, Guide and Pioneer data were combined.

Figure 2. MBARI'S ROV *Tiburon*

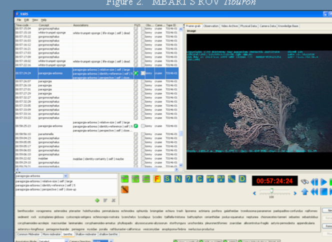


Figure 3. MBARI'S Video Annotation Reference System (VARS) user interface.

Results & Discussion

We traversed more than 36 km and analyzed 120 hours of video (Table 2). A total 90,329 individuals were annotated; 28,338 were corals. The highest number of organisms per km was at Guide/Pioneer (Table 2). Note that because these investigations were not conducted specifically for biological study these results are not strictly quantitative. The majority of animals were suspension and filter feeders (Fig. 4). Rodriguez Seamount had a relatively high percentage of deposit feeders (19%) compared to the other seamounts (~8%). The presence of abundant deposit feeders *Pannychia moseleyi* (a holothurian) and a new species of echinoid account for this difference. Their numbers are likely due to the flat, relatively sediment-covered habitat of this seamount.

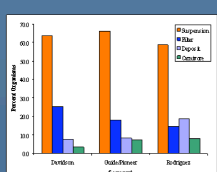


Figure 4. Feeding modes of observed organisms.

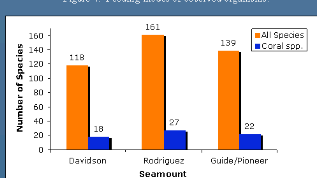


Figure 5. Number of distinct species at each seamount.

Table 2. Hours of video annotated, distance traversed and number of organisms observed.

Location	Observation Time (hrs of video)	Distance Traversed (km)	Organisms Observed	Organisms per km Traversed
Davidson	47	11.8	23,916	2,027
Rodriguez	47	16.3	39,189	2,404
Pioneer/Guide	26	8.3	27,224	3,280

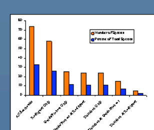


Figure 6. Number and percentage of species in common at each seamount

We found a total of 225 distinct species of which 33 were corals representing no fewer than 17 families (Fig. 5). Rodriguez Seamount was the most diverse in both total number of species and number of coral species (Fig. 5). Fewer than 33% of the total species were found at all of the studied seamounts. More than 25% of the total species were found on Rodriquez alone (Fig. 6). It appears that even more species would be found at these sites with continued sampling (Fig. 7). Corals may have been well-sampled as the number of species did not increase with additional sampling (Fig. 7).

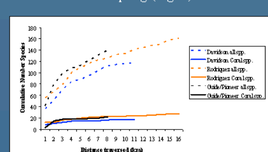


Figure 7. Cumulative species curve showing both total and coral species per distance traversed.

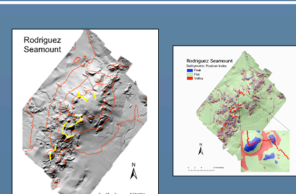


Figure 8. Rodriguez w/500 m contours & BPI analysis.

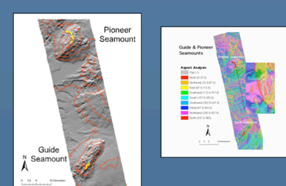


Figure 9. Guide & Pioneer w/500 m contours & aspect analysis.

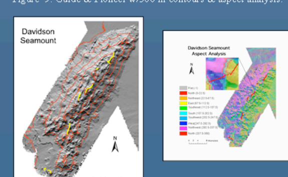


Figure 10. Davidson w/500 m contours & aspect analysis.

BPI Analysis: A significantly higher than expected percentage of deep-sea corals were found on peaks at Davidson (65.9%, p = 0.01) and Guide/Pioneer (82.6%, p <0.001) Seamounts. Lower than expected numbers were found in valleys and on flat terrain.

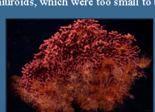
These results are similar to a previous study of Davidson seamount which showed that habitat forming corals were strongly associated with peaks (DeVogelaere et al. 2005).

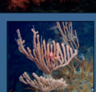
Aspect Analysis: Significantly higher than expected percentages of five large complexly branched habitat-forming corals were found on northwest- and west-facing slopes of Davidson (NW = 30%, W = 16.9%, p = <0.001) and Guide /Pioneer (W = 43.9%, NW = 17.8%, p = 0.003) Seamounts. Davidson also had a higher than expected number of corals on east-facing slopes (20.5%). Prevailing currents are likely the cause of these observed distribution patterns.

Neither of these analyses showed significant patterns at Rodriquez Seamount which is flat-topped and sediment veneered.

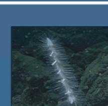
Coral Associates

Five commonly observed corals were often found associated with other organisms. The asteroids *Hippasteria spinosa* and *H. californica* were frequently seen grazing on the isidid corals *Keratoisis sp*. and *Isidella sp*. Brittle stars, basket stars, crinoids, and galatheid, lithodid, and majiid crabs were seen clinging to the branches of *Paragorgia arborea, Paragorgia sp*., and *Acanthogorgia*. Other organisms found on sampled corals included polychaete worms and ophiuroids, which were too small to be identified from video.

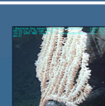




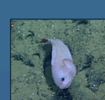
Sperosoma sp. nov.



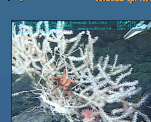
Cladorhiza sp. nov.



Isidella sp. nov.



Liparidae sp. nov.



Evoplosoma sp. nov.

New Species

Five new species were discovered through this research; two of them were found only on Rodriguez Seamount.

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M B A R I

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